

## CLAIMS

What is claimed is:

1. A message passing fabric modular processor system comprising:  
a plurality of processing elements, each element accessing a set of available  
5 processing elements;  
a plurality of message ports in communication with each processing  
element, each pair of message ports on adjacent processing elements  
defining a message path therebetween;  
addressing means associated with each processing element for indicating the  
10 destination of a message in the fabric;  
prioritization means associated with each processing element and each  
message port for determining which message port is to be given access to  
the associated processing element or message port;  
wherein the fabric asynchronously establishes routes for synchronous  
15 messages from an origin processing element to a destination processing  
element to permit an operation to occur at the destination processing  
element.
2. The message passing fabric modular processor system of claim 1 wherein the  
20 processing elements are selected from the set of central processing units, arithmetic  
logic units, memory elements, arbitrary function generators, state machines, digital  
signal processors, analog signal processors, programmable logic devices, field  
programmable gate arrays, complex programmable logic devices, input elements,  
output elements, and general purpose logic elements.
- 25 3. The message passing fabric modular processor system of claim 2 wherein the  
fabric is comprised of heterogeneous processing elements.
4. The message passing fabric modular processor system of claim 2 wherein the  
30 fabric is comprised of multiple sets of heterogeneous processing elements.

5. The message passing fabric modular processor system of claim 4 wherein the type of processing elements is selected based upon the computational characteristics of a predetermined computational task to be performed by the system.

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6. The message passing fabric modular processor system of claim 5 wherein the proportions of processing element types are selected based upon the computational characteristics of a predetermined computational task to be performed by the system.

10 7. The message passing fabric modular processor system of claim 4 wherein the spatial arrangement of processing elements is selected based upon the computational characteristics of a predetermined computational task to be performed by the system.

15 8. The message passing fabric modular processor system of claim 6 wherein the spatial arrangement of processing elements is selected based upon the computational characteristics of a predetermined computational task to be performed by the system.

20 9. The message passing fabric modular processor system of claim 4 wherein the type, proportion, and spatial arrangement of processing elements are selected to increase the availability of processing elements under conditions of high utilization of processing elements.

25 10. The message passing fabric modular processor system of claim 1 wherein the length of each message path is one processing unit interconnection in one dimension of the fabric.

30 11. The message passing fabric modular processor system of claim 6 wherein the addressing means decodes the address of the message destination and determines the shortest next destination address within the fabric.

12. The message passing fabric modular processor system of claim 10 wherein the addressing means selects an alternative next-shortest destination address if the prior determined address is unavailable.

5 13. The message passing fabric modular processor system of claim 1 wherein the set of available processing elements of each processing element in the fabric is stored in a modifiable data structure.

10 14. The message passing fabric modular processor system of claim 13 wherein the data contained in each modifiable data structure is modified based upon the computational characteristics of a predetermined computational task to be performed by the system.

15 15. The message passing fabric modular processor system of claim 1 wherein the arbitration means comprises means to prevent deadlock over access to processing elements or message paths.

20 16. The message passing fabric modular processor system of claim 1 wherein asynchronous establishment of routes for synchronous messaging from an origin processing element to a destination processing element requires no flow control protocol to be implemented in the route from the origin processing element to the destination processing element.

25 17. The message passing fabric modular processor system of claim 1 wherein message collisions are detected, and contending processing elements are independent in the time domains in which each of them retries messaging is independent of the other.

30 18. The message passing fabric modular processor system of claim 12 wherein the path to an alternative next-shortest destination address may be orthogonal to the path to the destination address if the absolute value in the time-to-live register is positive.

19. The message passing fabric modular processor system of claim 18 wherein upon selection of an orthogonal path causes the absolute value of the time-to-live register to be decremented.

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20. A method for message passing in a modular processor system comprising the steps of:

Providing a plurality of processing elements, each element accessing a set of available processing elements;

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Providing a plurality of message ports in communication with each processing element, each pair of message ports on adjacent processing elements defining a message path therebetween;

Associating an addressing means with each processing element for indicating the destination of a message in the fabric;

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Associating a prioritization means with each processing element and each message port for determining which message port is to be given access to the associated processing element or message port;

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wherein the fabric asynchronously establishes routes for synchronous messages from an origin processing element to a destination processing element thereby permitting an operation to occur at the destination processing element.